

Johnson & Johnson Surgical Vision, Inc. **TEST REPORT**

SCOPE OF WORK

FCC 15.247 TESTING – VERITAS REMOTE CONTROL

REPORT NUMBER

104086841LAX-021

ISSUE DATE

April 23, 2020

REVISED DATE

September 01, 2020

PAGES

41

DOCUMENT CONTROL NUMBER

Non-Specific Radio Report Shell Rev. December 2017
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EMC TEST REPORT

(FULL COMPLIANCE)

Report Number: 104086841LAX-021

Project Number: G104086841

Original Report Issue Date: April 23, 2020

Revision Report Issue Date: September 01, 2020

Model(s) Tested: VRT680135

Standards: FCC CFR47 Part 15 Subpart C, January 2020

Intentional Radiator

§15.247, Operation within the bands 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz

ISED RSS-247 Issue 2, February 2017

Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices

ISED RSS-Gen Issue 5, April 2018

General Requirements for Compliance of Radio Apparatus

Tested by:

Intertek

25791 Commercentre Drive

Lake Forest, CA 92630

USA

Client:

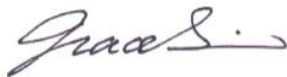
Johnson & Johnson Surgical Vision, Inc.

1700 East St., Andrew Place

Santa Ana, CA 92705

USA

Report prepared by



Grace Lin

EMC Staff Engineer

Report reviewed by



Krishna Vemuri

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1 Introduction and Conclusion

The tests indicated in section 2.0 were performed on the product constructed as described in section 4.0. The remaining test sections are the verbatim text from the actual data sheets used during the investigation. These test sections include the test name, the specified test Method, a list of the actual Test Equipment Used, documentation Photos, Results and raw Data. No additions, deviations, or exclusions have been made from the standard(s) unless specifically noted.

Based on the results of our investigation, we have concluded the product tested **complies** with the requirements of the standard(s) indicated. The results obtained in this test report pertain only to the item(s) tested. Intertek does not make any claims of compliance for samples or variants which were not tested.

2 Test Summary

Section	Test full name	Result
3	Client Information	-
4	Description of Equipment Under Test and Variant Models	-
5	System Setup and Method	-
6	6 dB Bandwidth and 99% Bandwidth (FCC §15.247(a)(2), ISED RSS-247 §5.2a; ISED RSS-Gen §6.7)	Compliant
7	Maximum Peak Conducted Output Power at Antenna Terminals (FCC §15.247(b)(3), ISED RSS-247 §5.4d)	Compliant
8	Maximum Power Spectral Density (FCC §15.247(e), ISED RSS-247 §5.2b)	Compliant
9	Conducted Spurious Emissions (FCC §15.247(d), ISED RSS-247 §5.5)	Compliant
10	Radiated Spurious Emissions (FCC §15.247(d), §15.209, §15.205, ISED RSS-247 §5.5, ISED RSS-Gen §8.9)	Compliant
11	AC Mains Conducted Emissions (FCC §15.207, ISED RSS-Gen §8.8)	Not Applicable*
12	Revision History	-

*: The EUT is battery powered

3 Client Information

This EUT was tested at the request of:

Client: Johnson & Johnson Surgical Vision, Inc.
1700 East St., Andrew Place
Santa Ana, CA 92705
USA

Contact: Kathryn Lockwood
Telephone: 714 247 8677
Email: klockwoo@its.jnj.com

4 Description of Equipment Under Test and Variant Models

Manufacturer: Johnson & Johnson Surgical Vision, Inc.
1700 East St., Andrew Place
Santa Ana, CA 92705
USA

Equipment Under Test			
Description	Manufacturer	Model Number	Serial Number
Veritas Remote Control	Johnson & Johnson Surgical Vision, Inc.	VRT680135	109100112 (conducted, PCB#1637000709) 109100112 (RSE & OBW, PCB#1637000701)

Receive Date:	01/27/2020	Test Started	01/27/2020
Received Condition:	Good	Test Ended	08/28/2020
Type:	Production		

Description of Equipment Under Test (provided by client)

The equipment under test is a remote control containing a Bluetooth Low Energy 4.1 transmitter operating at 2.4 GHz.

Equipment Under Test Power Configuration			
Rated Voltage	Rated Current	Rated Frequency	Number of Phases
3 Vdc (2 x AA Batteries)	-	-	-

Operating modes of the EUT:

No.	Descriptions of EUT Exercising
1	Test Mode – The EUT transmits continuously.

Software used by the EUT:

No.	Descriptions of EUT Exercising
1	Under test mode, the EUT was programmed to transmit continuously during testing.

Radio/Receiver Characteristics	
Frequency Band(s)	2402 MHz – 2480 MHz
Modulation Type(s)	GFSK
Maximum Output Power	-3.23 dBm (0.475 mW)
Test Channels	2402 MHz, 2440 MHz, 2480 MHz
Occupied Bandwidth	768 kHz (6 dB), 1100 kHz (99%)
Frequency Hopper: Number of Hopping Channels	Not Applicable
Frequency Hopper: Channel Dwell Time	Not Applicable
Frequency Hopper: Max interval between two instances of use of the same channel	Not Applicable
MIMO Information (# of Transmit and Receive antenna ports)	Not Applicable
Equipment Type	Standalone
Antenna Type and Gain	Permanent attached antenna. Gains*: 2.0 dBi (2.38 GHz), 2.45 dBi (2.45 GHz), 2.0 dBi (2.6 GHz).
* Antenna gains were provided by the client. Intertek takes no responsibility for the accuracy of the values listed	

Variant Models:

The following variant models were not tested as part of this evaluation but have been identified by the manufacturer as being electrically identical models, depopulated models, or with reasonable similarity to the model(s) tested. Intertek does not make any claims of compliance for samples or variants which were not tested.

➤ None

5 System Setup and Method

Cables					
ID	Description	Length (m)	Shielding	Ferrites	Termination
1	-	-	-	-	-

Support Equipment			
Description	Manufacturer	Model Number	Serial Number
-	-	-	-

5.1 Method:

Configuration as required by ANSI C63.10-2013.

5.2 Test Setup Block Diagram:



6 DTS (6 dB) Bandwidth and 99% Bandwidth

6.1 Requirement(s)

The minimum DTS (6 dB) bandwidth shall be at least 500 kHz.

6.2 Method

- A. The procedure described in ANSI C63.10-2013 and FCC Publication 558074 D01 15.247 Meas Guidance v05r02, April 2, 2019 was used to determine the DTS (6 dB) bandwidth. Section 8.2 was used.
 - a) Set RBW = 100 kHz.
 - b) Set the video bandwidth (VBW) $\geq 3 \times$ RBW.
 - c) Detector = Peak.
 - d) Trace mode = max hold.
 - e) Sweep = auto couple.
 - f) Allow the trace to stabilize.
 - g) Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission.
- B. The following procedure was used for measuring 99% power bandwidth.
 - a) The instrument center frequency is set to the nominal EUT channel center frequency. The frequency span for the spectrum analyzer shall be between 1.5 times and 5.0 times the OBW.
 - b) The nominal IF filter bandwidth (3 dB RBW) shall be in the range of 1% to 5% of the OBW, and VBW shall be approximately three times the RBW, unless otherwise specified by the applicable requirement.
 - c) Set the reference level of the instrument as required, keeping the signal from exceeding the maximum input mixer level for linear operation. In general, the peak of the spectral envelope shall be more than $[10 \log (\text{OBW}/\text{RBW})]$ below the reference level.
 - d) Step a) through step c) might require iteration to adjust within the specified range.
 - e) Video averaging is not permitted. Where practical, a sample detection and single sweep mode shall be used. Otherwise, peak detection and max hold mode (until the trace stabilizes) shall be used.
 - f) Use the 99% power bandwidth function of the instrument and report the measured bandwidth.

TEST SITE:

The test is performed in the wireless laboratory located at 25791 Commercentre Drive, Lake Forest, California 92630 USA. This test facility meets the requirements of CISPR 16-1-4 and has been accredited by A2LA. IC test site registration number is 2042T.

6.3 Test Equipment Used:

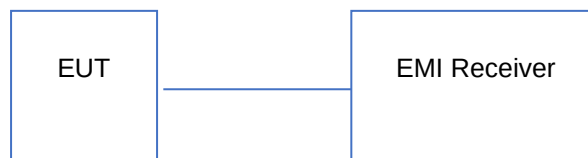
Asset	Description	Manufacturer	Model	Serial	Cal Date	Cal Due
1140	EMI Test Receiver	R&S	ESC17	100825	10/04/2019	10/04/2020
1015	Barometer Temp/Humidity	Omega	IBTHX-W	0480396	02/12/2019	02/12/2020

Software Utilized:

Name	Manufacturer	Version	Profile
N/A	N/A	N/A	N/A

6.4 Results:

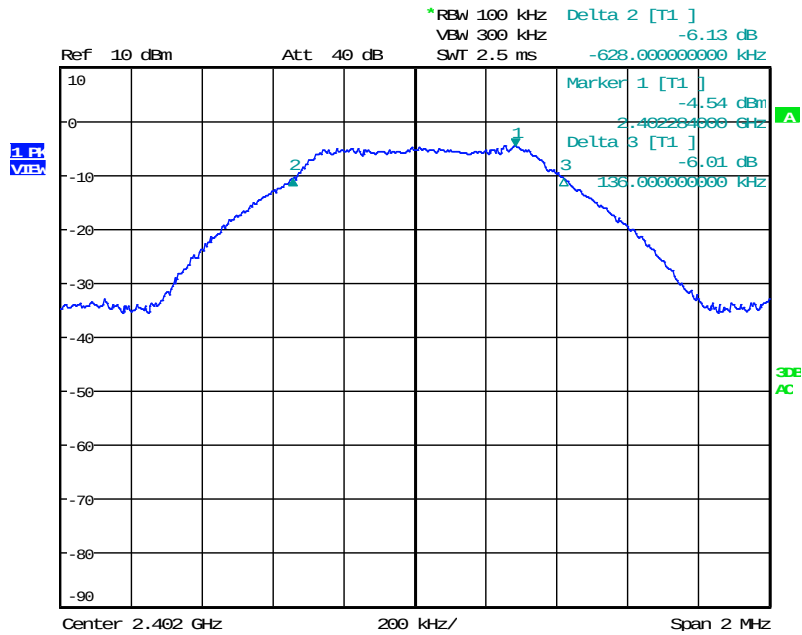
The sample tested was found to Comply.

6.5 Setup Diagram:**6.6 Plots/Data:**

Frequency (MHz)	6 dB Bandwidth (kHz)	99% Bandwidth (kHz)
2402	764	1084
2440	768	1088
2480	752	1080

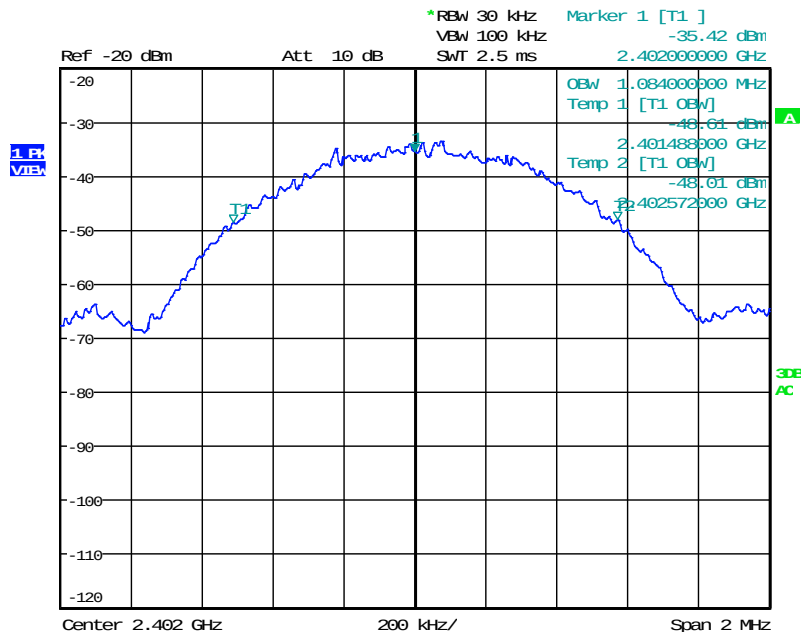
Note: The RF level in the plots is relative and is not the indication of RF output power.

6 dB Bandwidth, 2402 MHz:

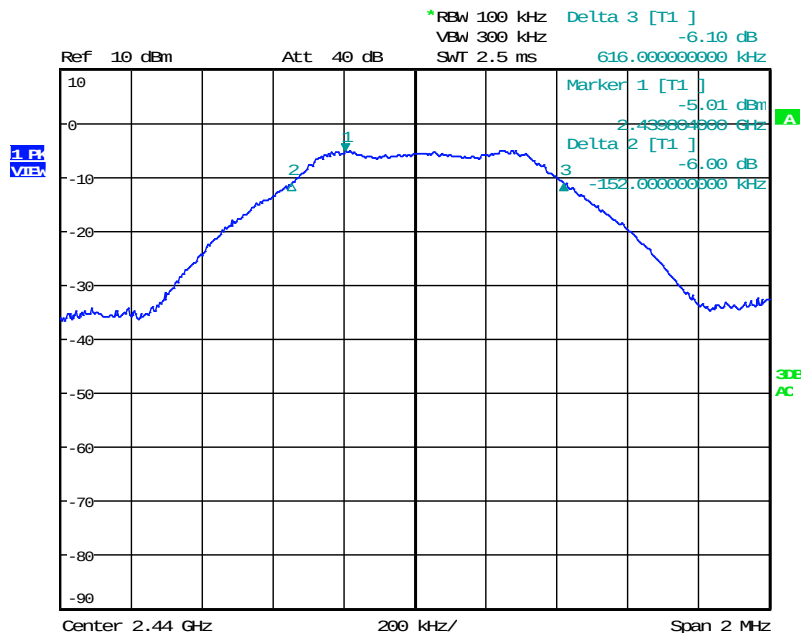


Date: 27.JAN.2020 17:03:42

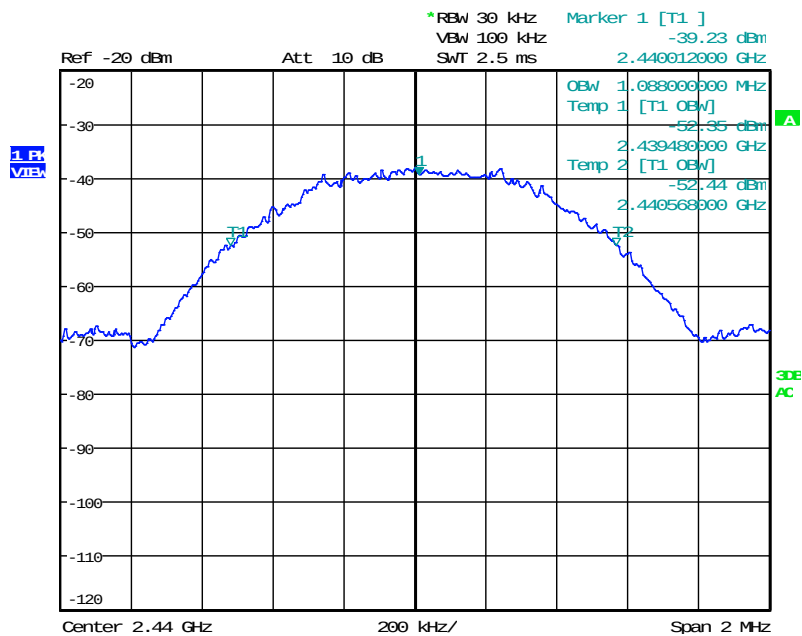
99% Bandwidth, 2402 MHz:



Date: 30.JAN.2020 18:38:05

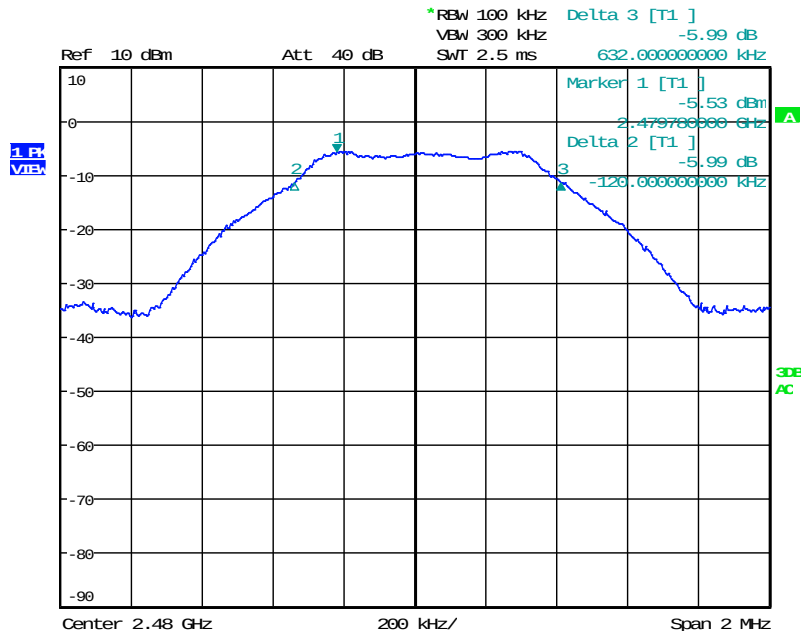
6 dB Bandwidth, 2440 MHz:

Date: 27.JAN.2020 17:11:25

99% Bandwidth, 2440 MHz:

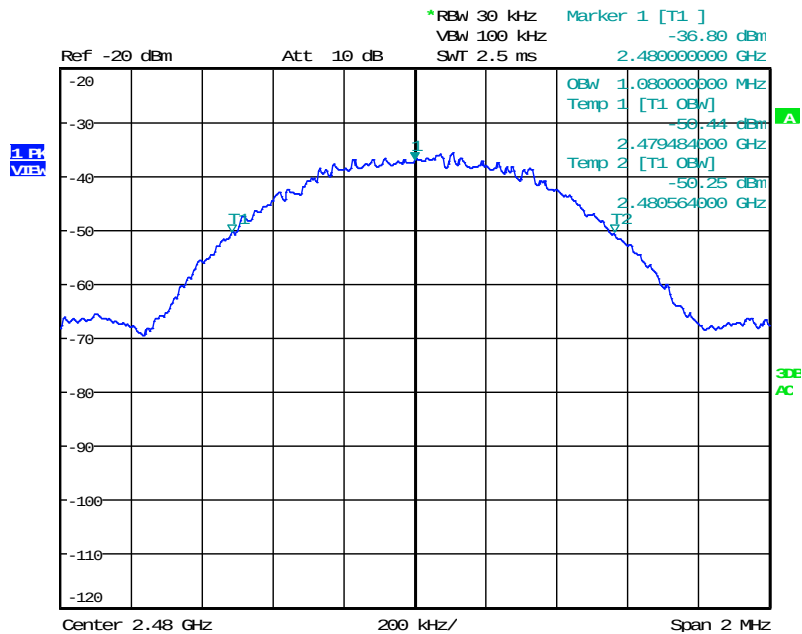
Date: 30.JAN.2020 18:41:38

6 dB Bandwidth, 2480 MHz:



Date: 27.JAN.2020 17:15:18

99% Bandwidth, 2480 MHz:



Date: 30.JAN.2020 18:43:30

Test Personnel:	Grace Lin
Product Standard:	FCC §15.247, ISED RSS-247
Input Voltage:	3 Vdc (2 x AA Batteries)
Pretest Verification w/ BB Source:	N/A

Test Date:	01/27/2020, 1/30/2020
Limit Applied:	FCC §15.247, ISED RSS-247
Ambient Temperature:	19.4 °C
Relative Humidity:	55 %
Atmospheric Pressure:	997.5 mbars

Deviations, Additions, or Exclusions: None

7 Maximum Peak Conducted Output Power at Antenna Terminals

7.1 Requirement(s)

For antennas with gains of 6 dBi or less, maximum allowed transmitter output is 1 watt or 30 dBm. For antennas with gains greater than 6 dBi, transmitter output level must be decreased appropriately, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

7.2 Method

The procedure described in ANSI C63.10-2013 and FCC Publication 558074 D01 15.247 Meas Guidance v05r02, April 2, 2019 was used. Specifically, Section 8.3.1.1 $RBW \geq DTS \text{ bandwidth}$ was utilized as the spectrum analyzer's resolution bandwidth was greater than the DTS bandwidth.

- a) Set the $RBW \geq DTS \text{ Bandwidth}$
- b) Set the $VBW \geq 3 \times RBW$
- c) Set the $\text{span} \geq 3 \times RBW$
- d) Sweep time = Auto couple
- e) Detector = Peak
- f) Trace mode = Max Hold
- g) Allow trace to fully stabilize
- h) Use peak marker function to determine the peak amplitude level.

TEST SITE:

The test is performed in the 3 meter semi-anechoic chamber located at 25791 Commercentre Drive, Lake Forest, California 92630 USA. This test facility meets the requirements of CISPR 16-1-4 and has been accredited by A2LA. IC test site registration number is 2042T.

7.3 Test Equipment Used:

Asset	Description	Manufacturer	Model	Serial	Cal Date	Cal Due
1140	EMI Test Receiver	R&S	ESCI7	100825	10/04/2019	10/04/2020
1015	Barometer Temp/Humidity	Omega	IBTHX-W	0480396	02/12/2019	02/12/2020

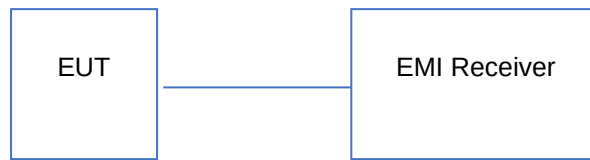
Software Utilized:

Name	Manufacturer	Version	Profile
N/A	N/A	N/A	N/A

7.4 Results:

The sample tested was found to Comply.

7.5 Setup Diagram:

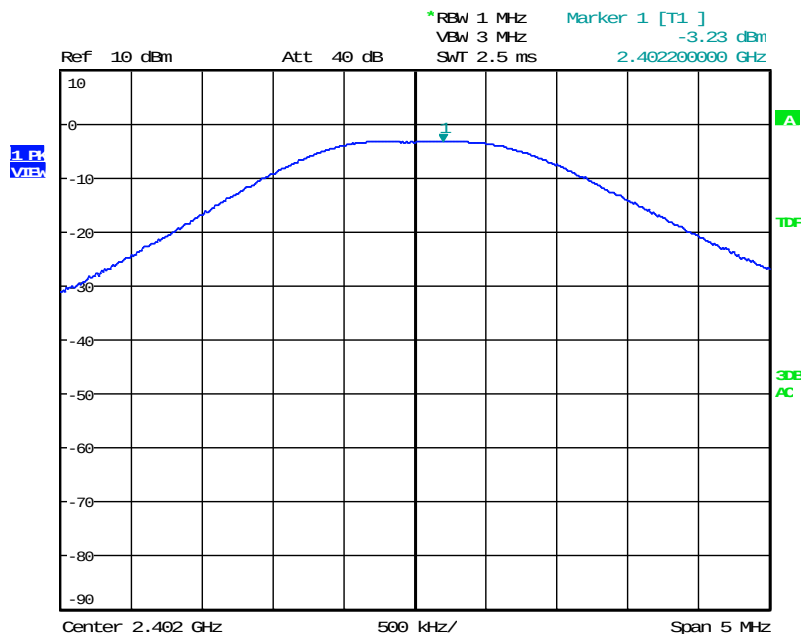


7.6 Plots/Data:

Frequency (MHz)	Peak Conducted Output Power	
	dBm	mW
2402	-3.23	0.475
2440	-4.08	0.391
2480	-4.71	0.338

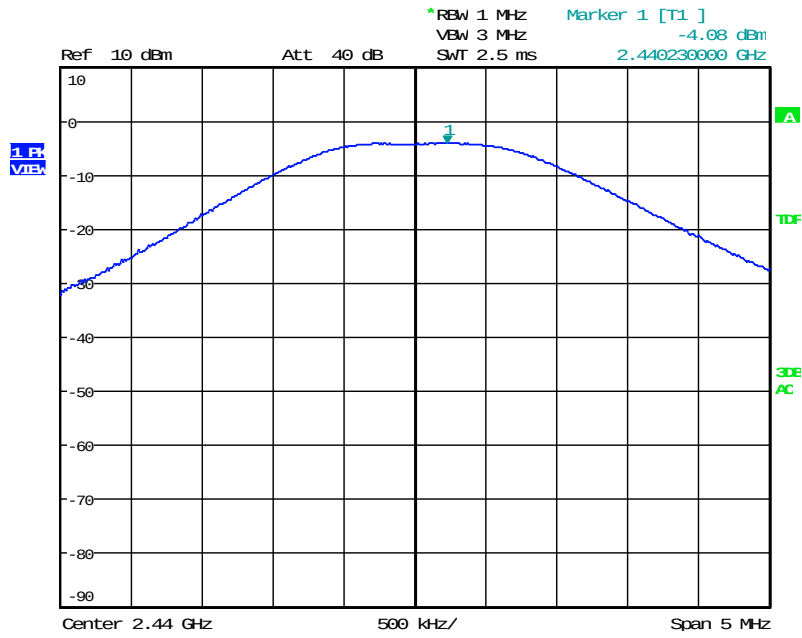
Note: The insertion loss was compensated for in the receiver

Output Power, 2402 MHz:



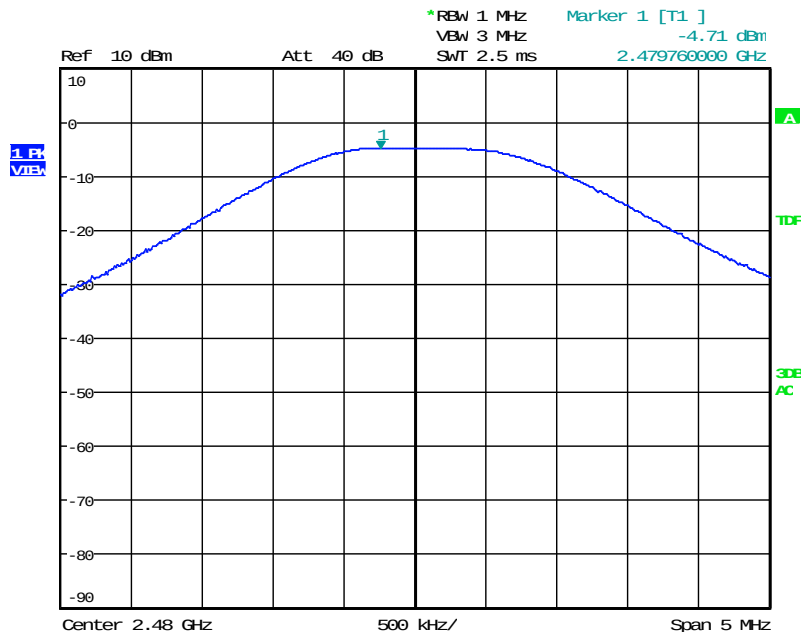
Date: 27.JAN.2020 17:24:32

Output Power, 2440 MHz:



Date: 27.JAN.2020 17:26:10

Output Power, 2480 MHz:



Date: 27.JAN.2020 17:22:45

Test Personnel:	Grace Lin
Product Standard:	FCC §15.247, ISED RSS-247
Input Voltage:	3 Vdc (2 x AA Batteries)
Pretest Verification w/ BB Source:	N/A

Test Date:	01/27/2020
Limit Applied:	FCC §15.247, ISED RSS-247
Ambient Temperature:	19.4 °C
Relative Humidity:	55 %
Atmospheric Pressure:	997.5 mbars

Deviations, Additions, or Exclusions: None

8 Maximum Power Spectral Density

8.1 Requirement(s)

For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna should not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

8.2 Method

The procedure described in ANSI C63.10-2013 and FCC Publication 558074 D01 15.247 Meas Guidance v05r02, April 2, 2019, specifically Section 8.4 *DTS maximum power spectral density level in the fundamental emission* was utilized.

- a) Set analyzer center frequency to DTS channel center frequency.
- b) Set the span to 1.5 times the *DTS bandwidth*.
- c) Set the RBW to: $3 \text{ kHz} \leq \text{RBW} \leq 100 \text{ kHz}$.
- d) Set the VBW $\geq 3 \times \text{RBW}$.
- e) Detector = peak.
- f) Sweep time = auto couple.
- g) Trace mode = max hold.
- h) Allow trace to fully stabilize.
- i) Use the peak marker function to determine the maximum amplitude level within the RBW.
- j) If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat.

TEST SITE:

The test is performed in the 3 meter semi-anechoic chamber located at 25791 Commercentre Drive, Lake Forest, California 92630 USA. This test facility meets the requirements of CISPR 16-1-4 and has been accredited by A2LA. IC test site registration number is 2042T.

8.3 Test Equipment Used:

Asset	Description	Manufacturer	Model	Serial	Cal Date	Cal Due
1140	EMI Test Receiver	R&S	ESCI7	100825	10/04/2019	10/04/2020
1015	Barometer Temp/Humidity	Omega	IBTHX-W	0480396	02/12/2019	02/12/2020

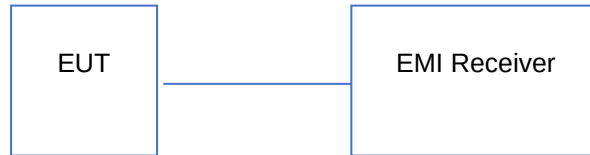
Software Utilized:

Name	Manufacturer	Version	Profile
N/A	N/A	N/A	N/A

8.4 Results:

The sample tested was found to Comply.

8.5 Setup Diagram:

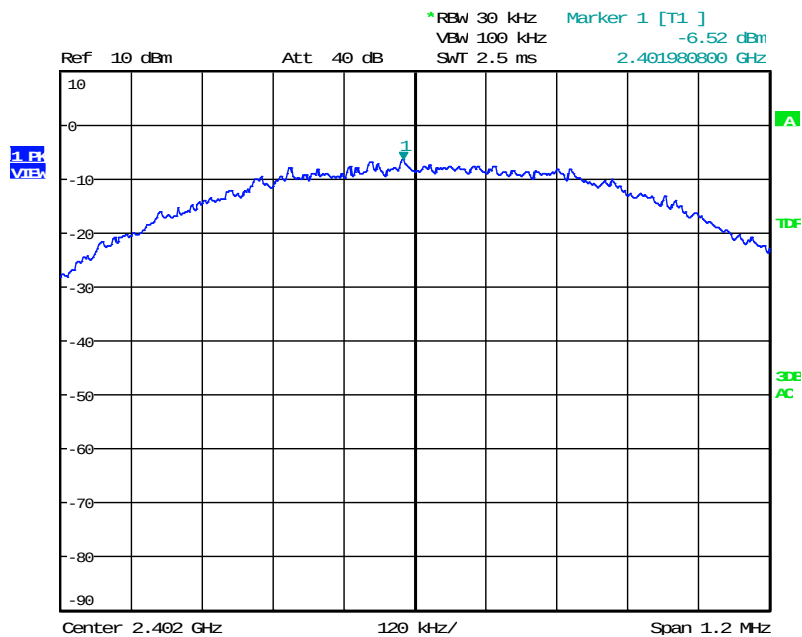


8.6 Plots/Data:

Frequency (MHz)	Maximum Power Spectral Density (dBm)
2402	-6.52
2440	-7.71
2480	-8.09

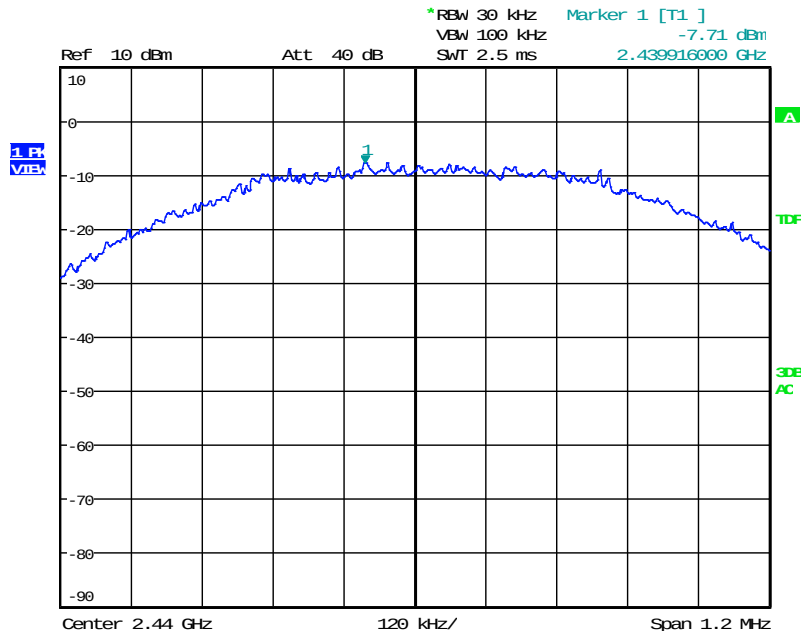
Note: The antenna port of the EUT connected directly to the input of the measuring EMI receiver.

PSD, 2402 MHz:



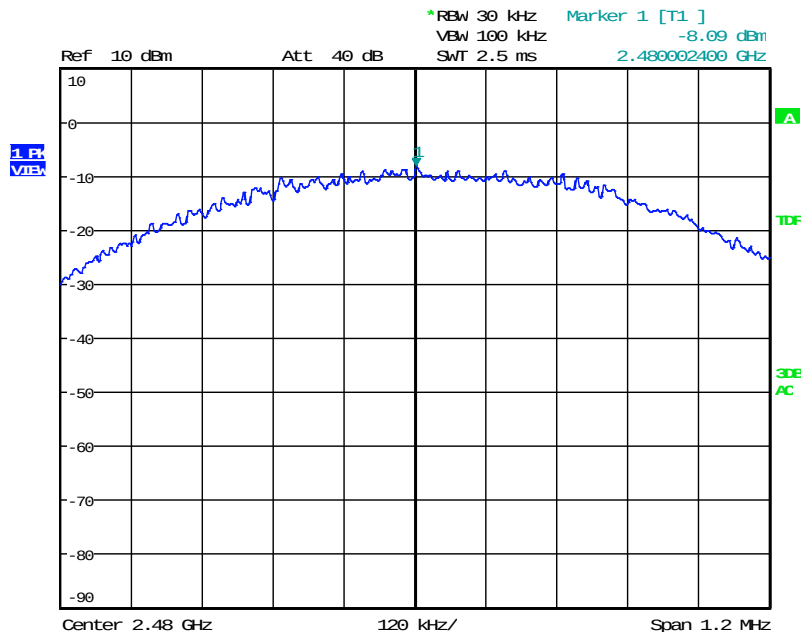
Date: 27.JAN.2020 17:38:51

PSD, 2440 MHz:



Date: 27.JAN.2020 17:35:00

PSD, 2480 MHz:



Date: 27.JAN.2020 17:36:20

Test Personnel:	Grace Lin
Product Standard:	FCC §15.247, ISED RSS-247
Input Voltage:	3 Vdc (2 x AA Batteries)
Pretest Verification w/ BB Source:	N/A

Test Date:	01/27/2020
Limit Applied:	FCC §15.247, ISED RSS-247
Ambient Temperature:	19.4 °C
Relative Humidity:	55 %
Atmospheric Pressure:	997.5 mbars

Deviations, Additions, or Exclusions: None

9 Conducted Spurious Emissions

9.1 Requirement(s)

In any 100 kHz bandwidth outside the frequency band, the radio frequency power shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of the RMS averaging over a time interval, the attenuation required shall be 30 dB instead of 20 dB.

In addition, radiated emissions which fall in the restricted bands, as defined in § 15.205(a), shall comply with the radiated emission limits specified in § 15.209(a)

9.2 Method

The procedure described in ANSI C63.10-2013 and FCC Publication 558074 D01 15.247 Meas Guidance v05r02, April 2, 2019. Specifically, Section 8.5 DTS emissions in non-restricted frequency bands was utilized.

A spectrum analyzer was connected to the antenna port of the transmitter.

- Set the RBW = 100 kHz.
- Set the VBW $\geq 3 \times$ RBW.
- Detector = peak.
- Sweep time = auto couple.
- Trace mode = max hold.
- Allow trace to fully stabilize.
- Use the peak marker function to determine the maximum amplitude level.

The unwanted emissions were measured from 30 MHz to 10 GHz. Plots below are corrected for cable loss and then compared to the limits. The RF level in the plots is relative and is not the indication of RF output power.

TEST SITE:

The test is performed in the 3 meter semi-anechoic chamber located at 25791 Commercentre Drive, Lake Forest, California 92630 USA. This test facility meets the requirements of CISPR 16-1-4 and has been accredited by A2LA. IC test site registration number is 2042T.

9.3 Test Equipment Used:

Asset	Description	Manufacturer	Model	Serial	Cal Date	Cal Due
1669	EMI Test Receiver	R&S	ESW44	101636	09/03/2019	09/03/2020
1015	Barometer Temp/Humidity	Omega	IBTHX-W	0480396	02/12/2019	02/12/2020

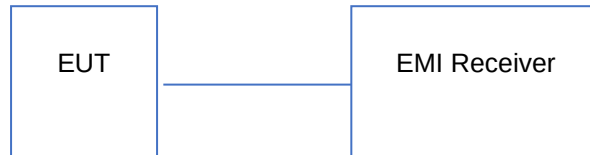
Software Utilized:

Name	Manufacturer	Version	Profile
-	-	-	-

9.4 Results:

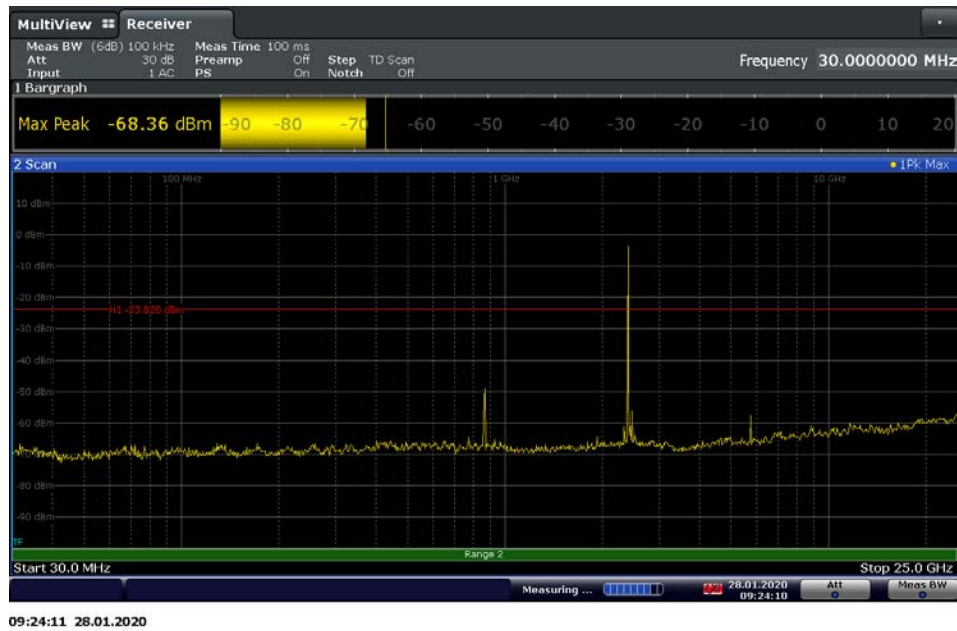
The sample tested was found to Comply. All the emissions outside of the frequency band were at least 20 dB below the carrier power level.

9.5 Setup Diagram:

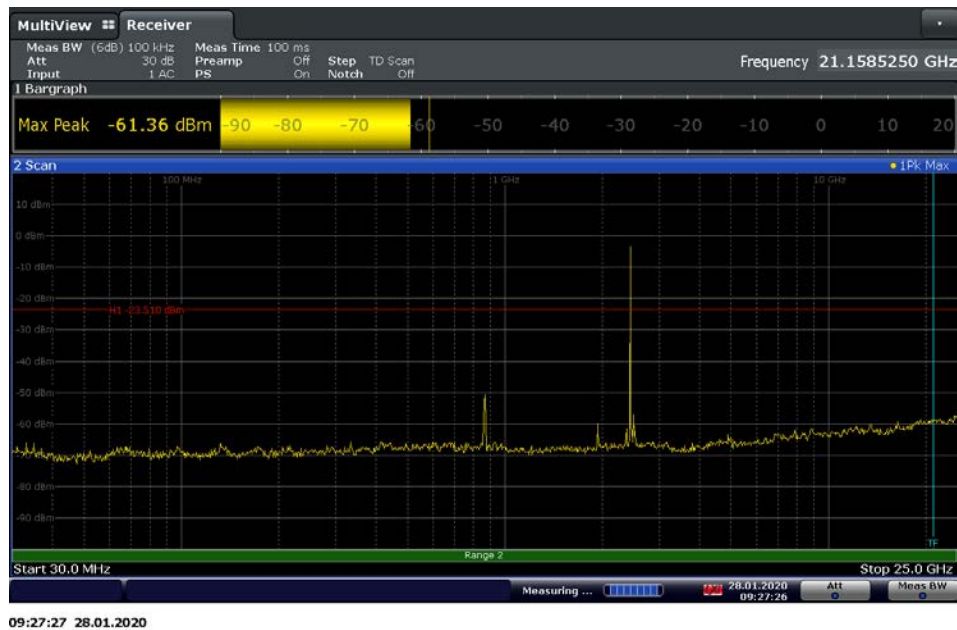


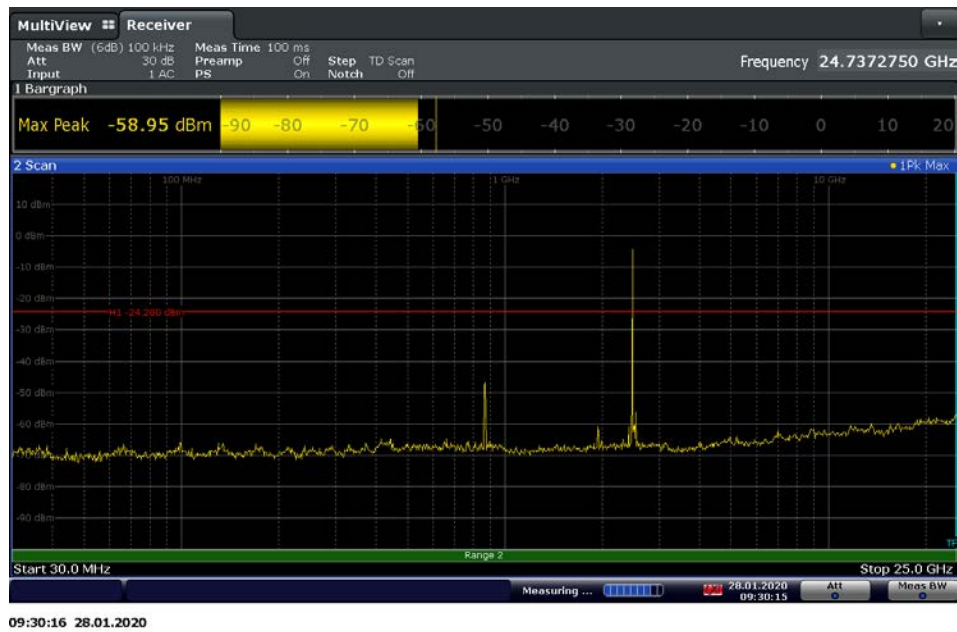
9.6 Plots/Data:

Conducted Spurious Emissions, 2402 MHz:



Conducted Spurious Emissions, 2440 MHz:



Conducted Spurious Emissions, 2480 MHz:**Bandedge, Low Channel:**

Bandedge, High Channel:



Test Personnel:	Grace Lin
Product Standard:	FCC §15.247, ISED RSS-247
Input Voltage:	3 Vdc (2 x AA Batteries)
Pretest Verification w/ BB Source:	N/A

Test Date:	01/28/2020
Limit Applied:	FCC §15.247, ISED RSS-247
Ambient Temperature:	19.4 °C
Relative Humidity:	55 %
Atmospheric Pressure:	997.5 mbars

Deviations, Additions, or Exclusions: None

10 Radiated Spurious Emissions

10.1 Requirement(s)

Radiated emissions which fall in the restricted bands, as defined in §15.205(a), shall comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

In any 100 kHz bandwidth outside the frequency band, the radio frequency power shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of the RMS averaging over a time interval, the attenuation required shall be 30 dB instead of 20 dB.

10.2 Method

EUT was configured to transmit continuously. Radiated emission measurements were performed from 9kHz to 25 GHz according to the procedure described in ANSI C64.10. Resolution bandwidth is 200 Hz for frequencies 9 kHz to 150 kHz, 9 kHz for frequencies 150 kHz to 30MHz, 120 kHz for frequencies 30 MHz to 1000 MHz and 1 MHz for frequencies above 1 GHz. Above 1 GHz, both Peak and Average measurements were performed. The Peak level of radiated emissions was measured with a peak detector. The Average level of radiated emissions was measured with an RMS detector with trace averaging.

The EUT is placed on a plastic turntable that is 80 cm in height for frequencies 9 kHz to 1000 MHz, 1.5 meters for frequency above 1000 MHz. If the EUT attaches to peripherals, they are connected and operational (as typical as possible). During testing, all cables were manipulated to produce worst-case emissions. The signal is maximized through rotation. The antenna height and polarization are varied during the search for maximum signal level. The antenna height is varied from 1 to 4 meters.

Radiated emissions are taken at 3 meters for frequencies below 18 GHz. For frequencies above 18 GHz, preliminary scan was performed at 0.1 meter. Final measurement was performed at 1 meter for any emissions detected at 0.1 meter.

EUT was tested at three orientations. Data included is representative of the worst-case configuration (the configuration which resulted in the highest emission levels). Plots below are corrected for distance, cables, preamp, filters and antenna factors then compared to the limits.

Correlation measurements were performed below 30MHz between 10m ALSE and Open Field site according to FCC KDB 414788 D01 Radiated Test Site v01r01 section 2. All readings were within the acceptable tolerance.

TEST SITE:

The test is performed in the 3 meter semi-anechoic chamber located at 25791 Commercentre Drive, Lake Forest, California 92630 USA. This test facility meets the requirements of CISPR 16-1-4 and has been accredited by A2LA. IC test site registration number is 2042T.

Measurement Uncertainty

Measurement	Frequency Range	Expanded Uncertainty (k=2)	U _{CISPR}
Radiated Emissions, 3m	30-1000 MHz	4.3	6.3 dB
Radiated Emissions, 3m	1-18 GHz	4.7	5.2 dB
Radiated Emissions, 3m	18-26.5 GHz	4.5	-

As shown in the table above our radiated emissions U_{lab} is less than the corresponding U_{CISPR} reference value in CISPR 16-4-2 Table 1, hence the compliance of the product is only based on the measured value, and no measurement uncertainty correction is required, based on CISPR 22 and CISPR 11 (for 2006 and later revisions) Clause 11.

Sample Calculation

The field strength is calculated by adding the Antenna Factor and Cable Factor, and subtracting the Amplifier Gain (if any) from the measured reading. The basic equation with a sample calculation is as follows:

$$FS = RA + AF + CF - AG$$

Where

FS = Field Strength in dB μ V/m

RA = Receiver Amplitude (including preamplifier) in dB μ V

CF = Cable Attenuation Factor in dB

AF = Antenna Factor in dB

AG = Amplifier Gain in dB

In the following table(s), the reading shown on the data table reflects the preamplifier gain. An example for the calculations in the following table is as follows.

Assume a receiver reading of 52.0 dB μ V is obtained. The antenna factor of 7.4 dB and cable factor of 1.6 dB is added. The amplifier gain of 29 dB is subtracted, giving a field strength of 32 dB μ V/m. This value in dB μ V/m was converted to its corresponding level in μ V/m.

$$RA = 52.0 \text{ dB}\mu\text{V}$$

$$AF = 7.4 \text{ dB/m}$$

$$CF = 1.6 \text{ dB}$$

$$AG = 29.0 \text{ dB}$$

$$FS = 32 \text{ dB}\mu\text{V/m}$$

To convert from dB μ V to μ V or mV the following was used:

$$UF = 10^{(NF / 20)} \text{ where } UF = \text{Net Reading in } \mu\text{V}$$

$$NF = \text{Net Reading in dB}\mu\text{V}$$

Example:

$$FS = RA + AF + CF - AG = 52.0 + 7.4 + 1.6 - 29.0 = 32.0$$

$$UF = 10^{(32 \text{ dB}\mu\text{V} / 20)} = 39.8 \mu\text{V/m}$$

10.3 Test Equipment Used:

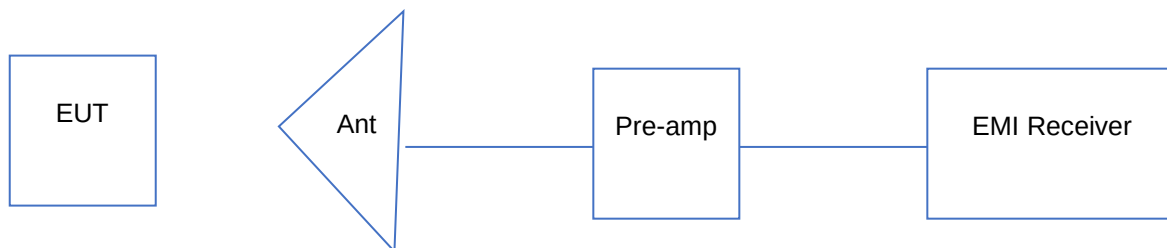
Asset	Description	Manufacturer	Model	Serial	Cal Date	Cal Due
637	3m Semi-anechoic Chamber	Panashield	3 meter	25 331-D-Z	December 2018	December 2021
1669	EMI Test Receiver	R&S	ESW44	101636	09/03/2019	09/03/2020
1707	Bilog Antenna	sunAR	JB6	A110618	09/26/2019	09/26/2020
1576	Pre-amp	R&S	TS-PR1	102068	01/13/2020	01/13/2021
1515	Horn Antenna	ETS-Lindgren	3115	00161631	04/17/2019	04/17/2020
1556	Pre-amp	R&S	TS-PR18	102144	08/18/2019	08/18/2020
880	Horn Antenna	ETS-Lindgren	3116	00153521	04/19/2019	04/19/2020
1557	Pre-amp	R&S	TS-PR1840	100054	01/13/2020	01/13/2021
1517	Cable	R&S	TSPR-B7	101528	08/28/2019	08/28/2020
1518	Cable	R&S	TSPR-B7	101529	08/28/2019	08/28/2020
1015	Barometer Temp/Humidity	Omega	IBTHX-W	0480396	02/12/2019	02/12/2020
00961	EMI Receiver	Rohde and Schwarz	ESU40	100172	03/09/2020	03/09/2021
10775	Horn Antenna	ETS-Lindgren	3177-PB	1GVT 416044801-	10/17/2019	10/17/2020
01408	RF Cable	Megaphase	EMC1-K1K1-236	1GVT 416044801	11/11/2019	11/11/2020
00984	10m Semi-anechoic Chamber	Panashield	10 Meter Chamber	NA	09/11/2018	09/11/2021
01598	Loop Antenna	EMCO	6512	1029	10/22/2019	10/22/2020
00942	Pre-amp	Sonoma	310	293620	04/14/2020	04/14/2021
01345	RF Cable	TRU Corp.	TRU Core 300	30B0711-080	04/13/2020	04/13/2021
01619	RF Cable	TRU Corp.	TRU Core 300	30B1111-020	04/13/2020	04/13/2021
01619	RF Cable	TRU Corp.	TRU Core 300	30B1111-150	04/13/2020	04/13/2021

Software Utilized:

Name	Manufacturer	Version	Profile
BAT-EMC	Nexio	3.18.0.16	LAX Intertek Emissions Template 03-30-2018

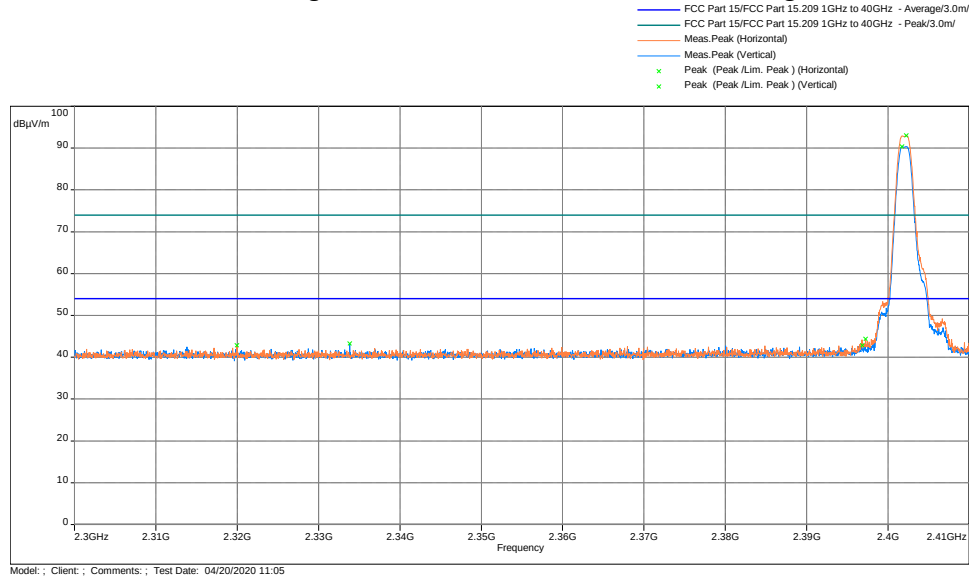
10.4 Results:

The sample tested was found to Comply.

10.5 Setup Diagram:

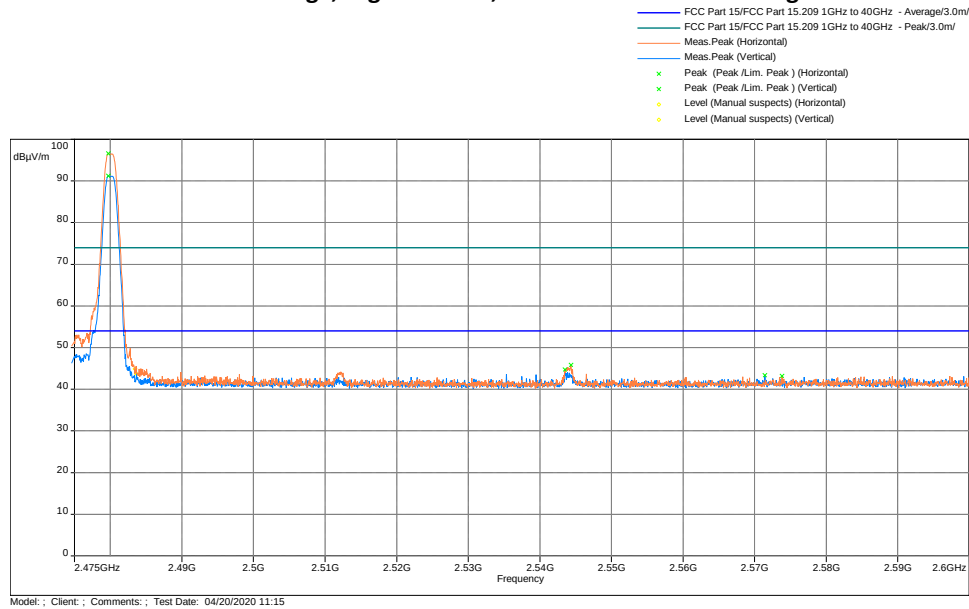
10.6 Plots/Data:

Radiated Band Edge, Low Channel, Peak Scan vs Peak and Avg Limits



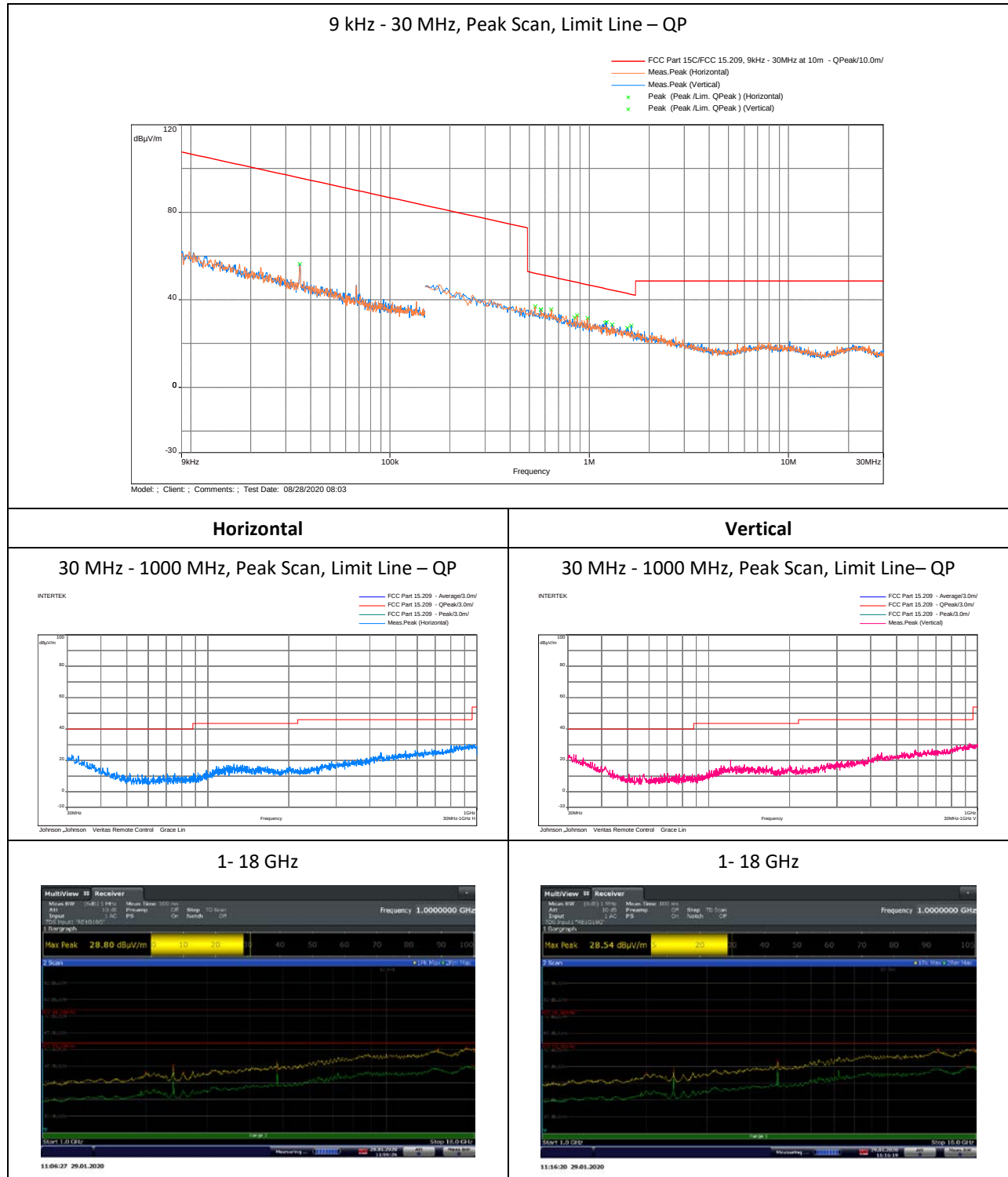
Frequency (MHz)	Peak Level @ 3m (dBμV/m)	Avg Limit @3m (dBμV/m)	Margin dB	Height (m)	Angle (°)	Position	Correction (dB)
2390	42.03	54	-11.97	1.50	1	Horizontal	5.1
2390	41.52	54	-12.48	2.49	264	Vertical	5.1

Radiated Band Edge, High Channel, Peak Scan vs Peak and Avg Limits



Frequency (MHz)	Peak Level @ 3m (dBμV/m)	Avg Limit @3m (dBμV/m)	Margin dB	Height (m)	Angle (°)	Position	Correction (dB)
2483.5	44.85	54	-9.15	1.52	189	Horizontal	5.2
2483.5	43.71	54	-10.29	1.51	124	Vertical	5.2

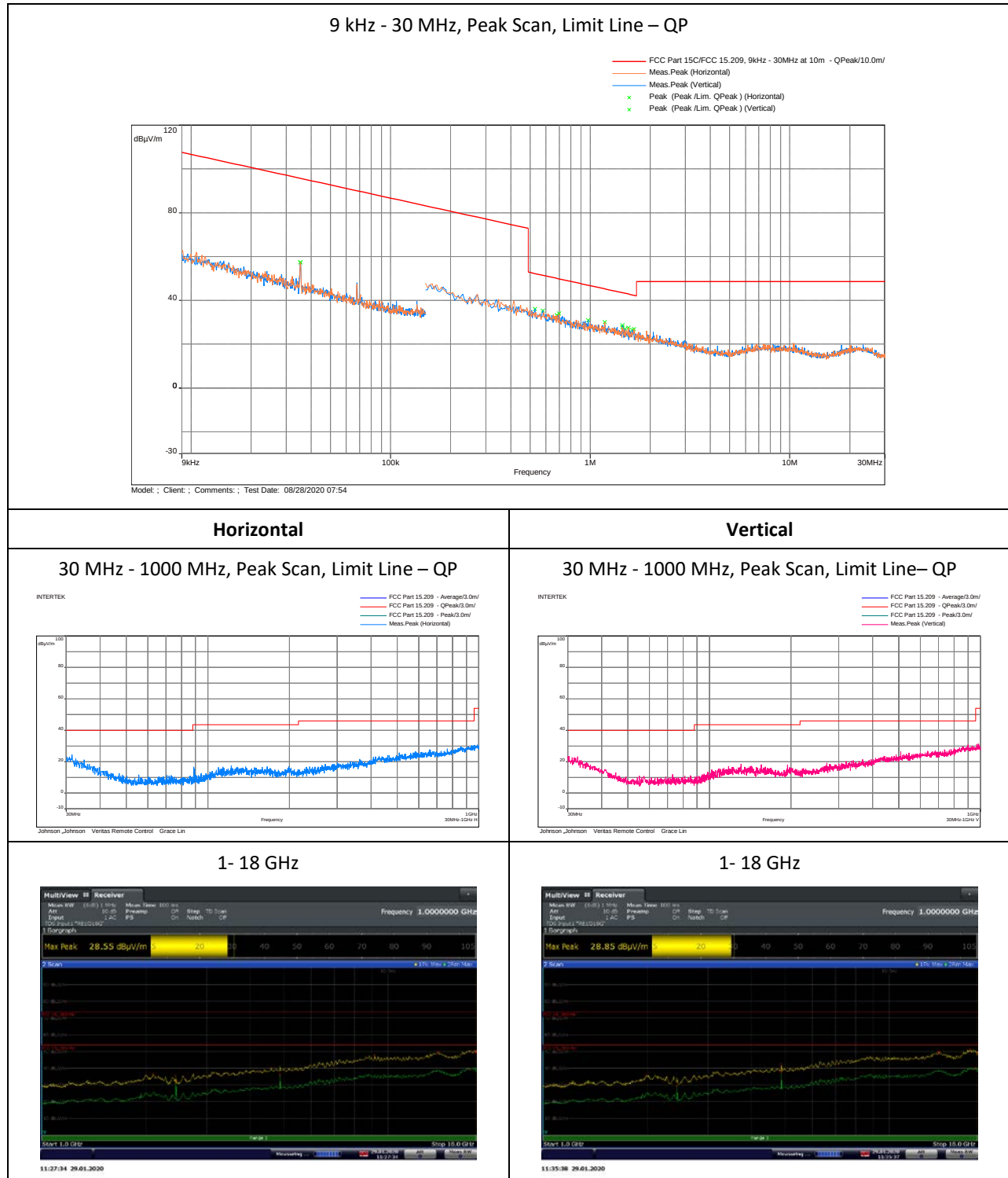
Radiated Spurious Emissions, 2402 MHz



Note: Radiated spurious emissions measurements were performed from 9kHz to 25 GHz.

10.6 Plots/Data: (Continued)

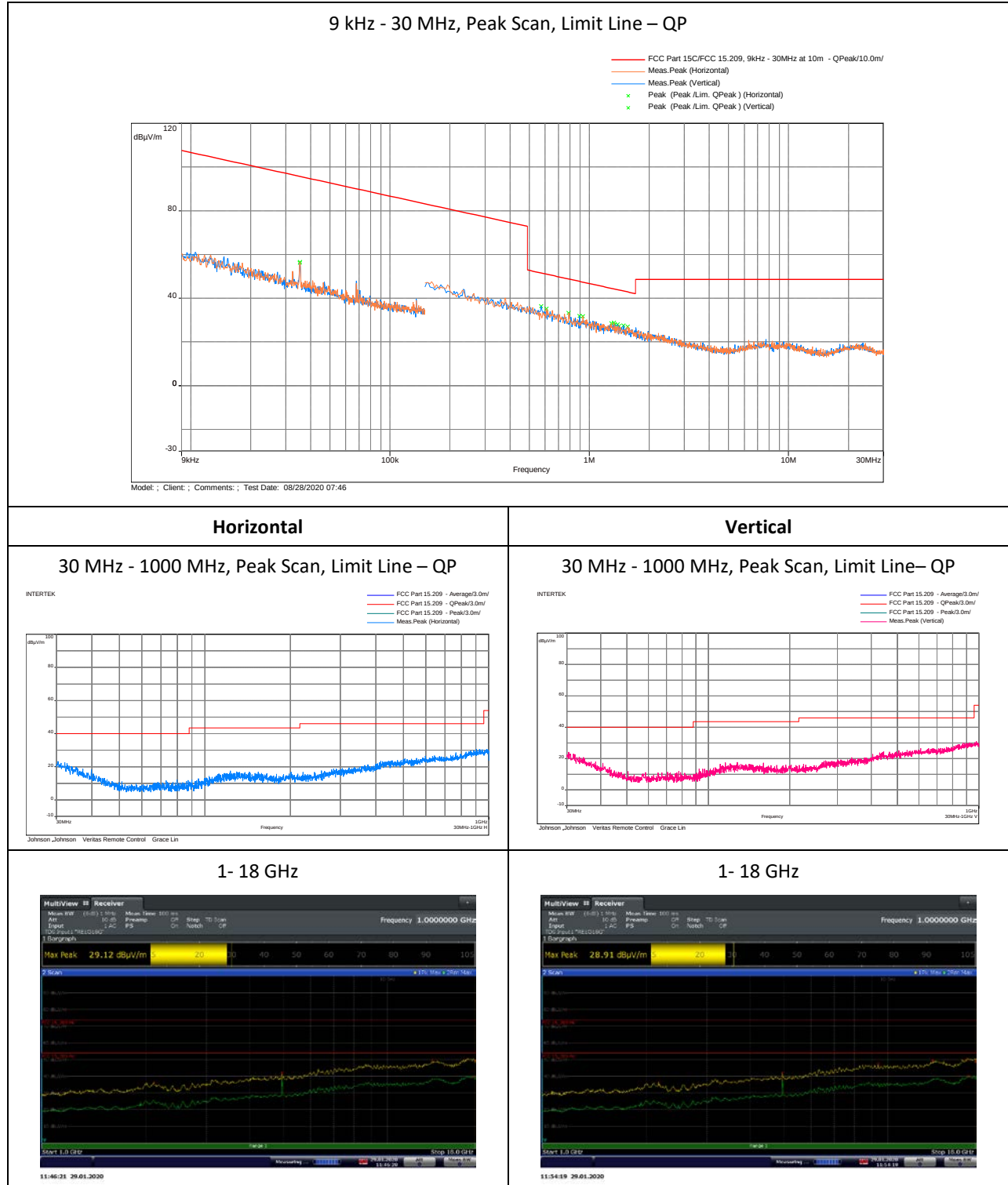
Radiated Spurious Emissions, 2440 MHz



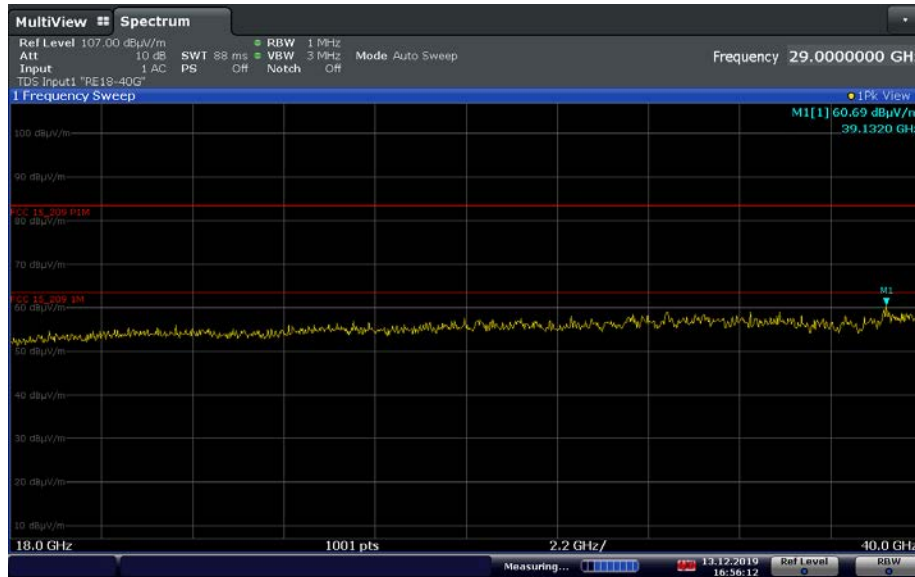
Note: Radiated spurious emissions measurements were performed from 9kHz to 25 GHz.

10.6 Plots/Data: (Continued)

Radiated Spurious Emissions, 2480 MHz



Note: Radiated spurious emissions measurements were performed from 9kHz to 25 GHz.



18-40 GHz Noise Floor with reference to limits at 0.1m and 1 m

10.6 Plots/Data: (Continued)

Radiated spurious emissions, 30 MHz – 1 GHz, 2402 MHz:

Frequency (MHz)	Peak (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Ant. Height (m)	Turntable Angle (°)	Ant. Pol.	Correction (dB)
31.26	23.71	40	-16.29	1.02	346	H	-5.04
901.25	30.25	46	-15.75	1.02	346	H	0.31
902.32	30.31	46	-15.69	1.02	346	H	0.31
923.27	29.82	46	-16.18	1.02	346	H	0.5
936.56	30.36	46	-15.64	1.02	346	H	0.67
954.12	29.75	46	-16.25	1.02	346	H	0.92
31.55	23.94	40	-16.06	4.01	0	V	-5.27
920.65	29.87	46	-16.13	4.01	0	V	0.36
932.10	30.91	46	-15.09	4.01	0	V	0.69
933.94	30.72	46	-15.28	4.01	0	V	0.63
938.50	30.29	46	-15.71	4.01	0	V	0.69
944.32	30.47	46	-15.53	4.01	0	V	0.83

Radiated spurious emissions, 30 MHz – 1 GHz, 2440 MHz:

Frequency (MHz)	Peak (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Ant. Height (m)	Turntable Angle (°)	Ant. Pol.	Correction (dB)
31.55	24.56	40	-15.44	1.02	0	H	-5.27
858.77	29.70	46	-16.30	1.02	0	H	0.11
935.59	30.01	46	-15.99	1.02	0	H	0.66
938.02	30.01	46	-15.99	1.02	0	H	0.69
940.83	30.39	46	-15.61	1.02	0	H	0.71
952.66	30.25	46	-15.75	1.02	0	H	0.93
30.29	23.59	40	-16.41	4.00	5	V	-4.35
859.06	29.57	46	-16.43	4.00	5	V	0.11
865.85	29.56	46	-16.44	4.00	5	V	0.25
897.37	30.13	46	-15.87	4.00	5	V	0.41
901.06	30.94	46	-15.06	4.00	5	V	0.32
934.23	30.14	46	-15.86	4.00	5	V	0.64

Radiated spurious emissions, 30 MHz – 1 GHz, 2480 MHz:

Frequency (MHz)	Peak (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Ant. Height (m)	Turntable Angle (°)	Ant. Pol.	Correction (dB)
903.10	30.64	46	-15.36	0.99	0	H	0.31
922.11	29.99	46	-16.01	0.99	0	H	0.39
923.47	30.29	46	-15.71	0.99	0	H	0.51
928.61	30.78	46	-15.22	0.99	0	H	0.59
932.29	30.09	46	-15.91	0.99	0	H	0.68
948.49	30.49	46	-15.51	0.99	0	H	0.94
30.49	24.18	40	-15.82	3.99	0	V	-4.48
874.87	30.09	46	-15.91	3.99	0	V	0.13
898.73	29.95	46	-16.05	3.99	0	V	0.34
922.40	30.08	46	-15.92	3.99	0	V	0.43
923.95	30.06	46	-15.94	3.99	0	V	0.51
926.47	29.73	46	-16.27	3.99	0	V	0.56

Radiated spurious emissions, above 1 GHz:

Antenna Polarization	Frequency (MHz)	Channel Freq. (MHz)	Final Field Strength (dBuV/m)	Limits (dBuV/m)	Margin (dB)	Tunable Degree	Antenna Height (cm)	Detector
H	2390	2402	39.43	74.00	-34.57	116.25	100.00	PK
H	2390	2402	27.17	54.00	-26.83	116.25	100.00	RMS
V	2390	2402	38.07	74.00	-35.93	128.00	110.00	PK
V	2390	2402	25.30	54.00	-28.70	128.00	110.00	RMS
H	4804	2402	43.74	74.00	-30.26	168.25	307.00	PK
H	4804	2402	36.48	54.00	-17.52	168.25	307.00	RMS
V	4804	2402	43.24	74.00	-30.76	130.00	113.00	PK
V	4804	2402	35.69	54.00	-18.31	130.00	113.00	RMS
H	4880	2440	42.59	74.00	-31.41	164.00	380.00	PK
H	4880	2440	35.66	54.00	-18.34	164.00	380.00	RMS
V	4880	2440	44.27	74.00	-29.73	254.75	371.00	PK
V	4880	2440	38.57	54.00	-15.43	254.75	371.00	RMS
H	7320	2440	45.11	74.00	-28.89	37.00	133.00	PK
H	7320	2440	34.24	54.00	-19.76	37.00	133.00	RMS
V	7320	2440	45.25	74.00	-28.75	283.00	117.00	PK
V	7320	2440	34.58	54.00	-19.42	283.00	117.00	RMS
H	2483.5	2480	44.97	74.00	-29.03	116.25	136.00	PK
H	2483.5	2480	34.42	54.00	-19.58	116.25	136.00	RMS
V	2483.5	2480	40.93	74.00	-33.07	133.50	100.00	PK
V	2483.5	2480	30.96	54.00	-23.04	133.50	100.00	RMS
H	4960	2480	44.71	74.00	-29.29	264.50	107.00	PK
H	4960	2480	39.32	54.00	-14.68	264.50	107.00	RMS
V	4960	2480	45.00	74.00	-29.00	322.00	100.00	PK
V	4960	2480	38.50	54.00	-15.50	322.00	100.00	RMS
H	7440	2480	46.37	74.00	-27.63	230.00	300.00	PK
H	7440	2480	34.52	54.00	-19.48	230.00	300.00	RMS
V	7440	2480	46.38	74.00	-27.62	270.00	222.00	PK
V	7440	2480	34.89	54.00	-19.11	270.00	222.00	RMS

Note: Radiated spurious emissions measurements were performed from 30 MHz to 25 GHz.

Test Personnel:	Grace Lin / Anderson Soungpanya	Test Date:	01/28/2020 – 01/30/2020, 04/20/2020 & 08/28/2020
Product Standard:	FCC §15.247, ISED RSS-247	Limit Applied:	FCC §15.209, RSS-Gen §8.9
Input Voltage:	3 Vdc (2 x AA Batteries)	Ambient Temperature:	19.4 °C
Pretest Verification w/ BB Source:	Yes	Relative Humidity:	55 %
		Atmospheric Pressure:	997.5 mbars

Deviations, Additions, or Exclusions: None

11 AC Mains Conducted Emissions

11.1 Performance Criterion

Frequency Band MHz	Conducted Limit dB(μV)	
	Quasi-Peak	Average
0.15-0.50	66 to 56 *	56 to 46 *
0.50-5.00	56	46
5.00-30.00	60	50

*Note: *Decreases linearly with the logarithm of the frequency
At the transition frequency the lower limit applies.*

11.2 Method

Tests are performed in accordance with ANSI C63.4-2014.

Measurements are carried out using quasi-peak and average detector receivers in accordance with CISPR 16. An AMN is required to provide a defined impedance at high frequencies across the power feed at the point of measurement of terminal voltage and also to provide isolation of the circuit under test from the ambient noise on the power lines. An AMN as defined in CISPR 16 shall be used.

The EUT is located so that the distance between the boundary of the EUT and the closest surface of the AMN is 0.8m.

Where a flexible mains cord is provided by the manufacturer, this shall be 1m long or if in excess of 1m, the excess cable is folded back and forth as far as possible so as to form a bundle not exceeding 0.4m in length.

The EUT is arranged and connected with cables terminated in accordance with the product specification.

Conducted disturbance is measured between the phase lead and the reference ground, and between the neutral lead and the reference ground. Both measured values are reported.

The EUT, where intended for tabletop use, is placed on a table whose top is 0.8m above the ground plane. A vertical, metal reference plane is placed 0.4m from the EUT. The vertical metal reference-plane is at least 2m by 2m. The EUT shall be kept at least 0.8m from any other metal surface or other ground plane not being part of the EUT. The table is constructed of non-conductive materials. Its dimensions are 1m by 1.5m, but may be extended for larger EUT.

Floor standing EUT are placed on a horizontal metal ground plane and isolated from the ground plane by resting on an insulating material. The metal ground plane extends at least 0.5m beyond the boundaries of the EUT and has minimum dimensions of 2m by 2m.

Equipment setup for conducted disturbance tests followed the guidelines of ANSI C63.4.

TEST SITE:

The test is performed in the 3 meter semi-anechoic chamber located at 25791 Commercentre Drive, Lake Forest, California 92630 USA. This test facility meets the requirements of CISPR 16-1-4 and has been accredited by A2LA. IC test site registration number is 2042T.

Measurement Uncertainty

Measurement	Frequency Range	Expanded Uncertainty (k=2)	Ucisp
AC Line Conducted Emissions	150 kHz - 30 MHz	2.1 dB	3.4dB

As shown in the table above our conducted emissions U_{lab} is less than the corresponding U_{CISPR} reference value in CISPR 16-4-2 Table 1, hence the compliance of the product is only based on the measured value, and no measurement uncertainty correction is required, based on CISPR 22 and CISPR 11 (for 2006 and later revisions) Clause 11.

Sample Calculations

The following is how net line-conducted readings were determined:

$$NF = RF + LF + CF + AF$$

Where NF = Net Reading in dB μ V

RF = Reading from receiver in dB μ V

LF = LISN or ISN Correction Factor in dB

CF = Cable Correction Factor in dB

AF = Attenuator Loss Factor in dB

To convert from dB μ V to μ V or mV the following was used:

$$UF = 10^{(NF / 20)} \text{ where } UF = \text{Net Reading in } \mu\text{V}$$

NF = Net Reading in dB μ V

Example:

$$NF = RF + LF + CF + AF = 28.5 + 0.2 + 0.4 + 20.0 = 49.1 \text{ dB}\mu\text{V}$$

$$UF = 10^{(49.1 \text{ dB}\mu\text{V} / 20)} = 285.1 \mu\text{V/m}$$

11.3 Test Equipment Used:

Asset	Description	Manufacturer	Model	Serial	Cal Date	Cal Due
-	-	-	-	-	-	-

Software Utilized:

Name	Manufacturer	Version	Profile
N/A	N/A	N/A	N/A

11.4 Results:

This test is not applicable as the equipment under test is battery powered.

12 Revision History

Revision Level	Date	Report Number	Prepared By	Reviewed By	Notes
0	04/23/2020	104086841LAX-021	GL/AS	KV	Initial Issue
1	09/01/2020	104086841LAX-021	AS	KV	Updated section 10 with below 30MHz radiated emissions test data